US009090070B2

(12) **United States Patent**
Yamamoto

(10) **Patent No.: US 9,090,070 B2**
(45) **Date of Patent: Jul. 28, 2015**

(54) **MAINTENANCE APPARATUS AND INKJET RECORDING APPARATUS**

(71) Applicants: **KABUSHIKI KAISHA TOSHIBA**, Minato-ku, Tokyo (JP); **TOSHIBA TEC KABUSHIKI KAISHA**, Shinagawa-ku, Tokyo (JP)

(72) Inventor: **Keizaburo Yamamoto**, Shizuoka-ken (JP)

(73) Assignees: **Kabushiki Kaisha Toshiba**, Tokyo (JP); **Toshiba Tec Kabushiki Kaisha**, Tokyo (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **14/048,203**

(22) Filed: **Oct. 8, 2013**

(65) **Prior Publication Data**

US 2014/0111577 A1 Apr. 24, 2014

(30) **Foreign Application Priority Data**

Oct. 18, 2012 (JP) 2012-230642

(51) **Int. Cl.**
B41J 2/015 (2006.01)
B41J 2/165 (2006.01)
B41J 2/21 (2006.01)

(52) **U.S. Cl.**
CPC ***B41J 2/16535*** (2013.01); *B41J 2/21* (2013.01)

(58) **Field of Classification Search**
USPC 347/33, 20
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2005/0007412 A1 1/2005 Nishikawa et al.
2006/0066664 A1 * 3/2006 Kachi et al. 347/33
2009/0153615 A1 6/2009 Chikamoto et al.

FOREIGN PATENT DOCUMENTS

JP 06-255117 9/1994
JP 11-300980 11/1999
JP 2003-011378 1/2003
JP 2005-022193 1/2005
JP 2009-143071 7/2009
JP 2012-153152 8/2012

OTHER PUBLICATIONS

Japanese Office Action for Japanese Patent Application No. 2012-230642 mailed Dec. 2, 2014.

* cited by examiner

Primary Examiner — Jason Uhlenhake
(74) *Attorney, Agent, or Firm* — Amin, Turocy & Watson, LLP

(57) **ABSTRACT**

According to one embodiment, there is provided a maintenance apparatus for removing ink from a nozzle surface of an inkjet head including a first region where a first nozzle is provided, a second region where a second nozzle is provided, and a third region located between the first region and the second region. The maintenance apparatus includes a first positioning section, a first wiping blade, and a second wiping blade. The first positioning section comes into contact with the third region and removes the ink present in the third region. When the first positioning section comes into contact with the third region, the first and second wiping blades come into contact with the first and second regions and remove the kinds of ink present in the first and second regions.

16 Claims, 8 Drawing Sheets

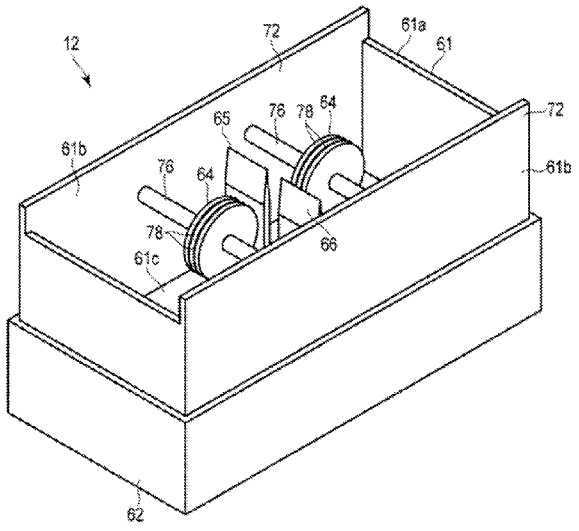


Fig.1

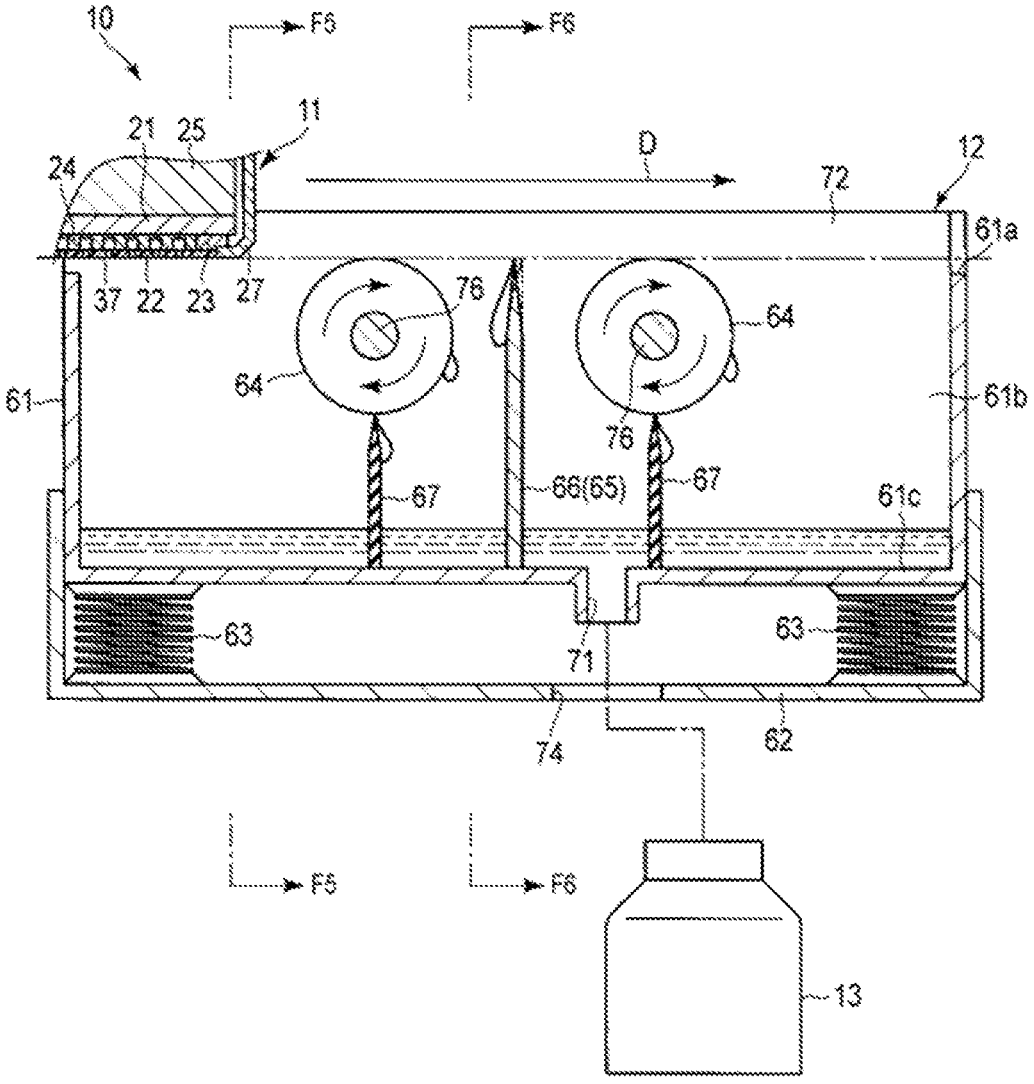

10
F5
F6
11
21
25
24
D
12
72
61a
37
22
23
27
76
64
64
61
61b
76
67
66(65)
67
61c
63
63
71
74
62
F5
F6
13

Fig.2

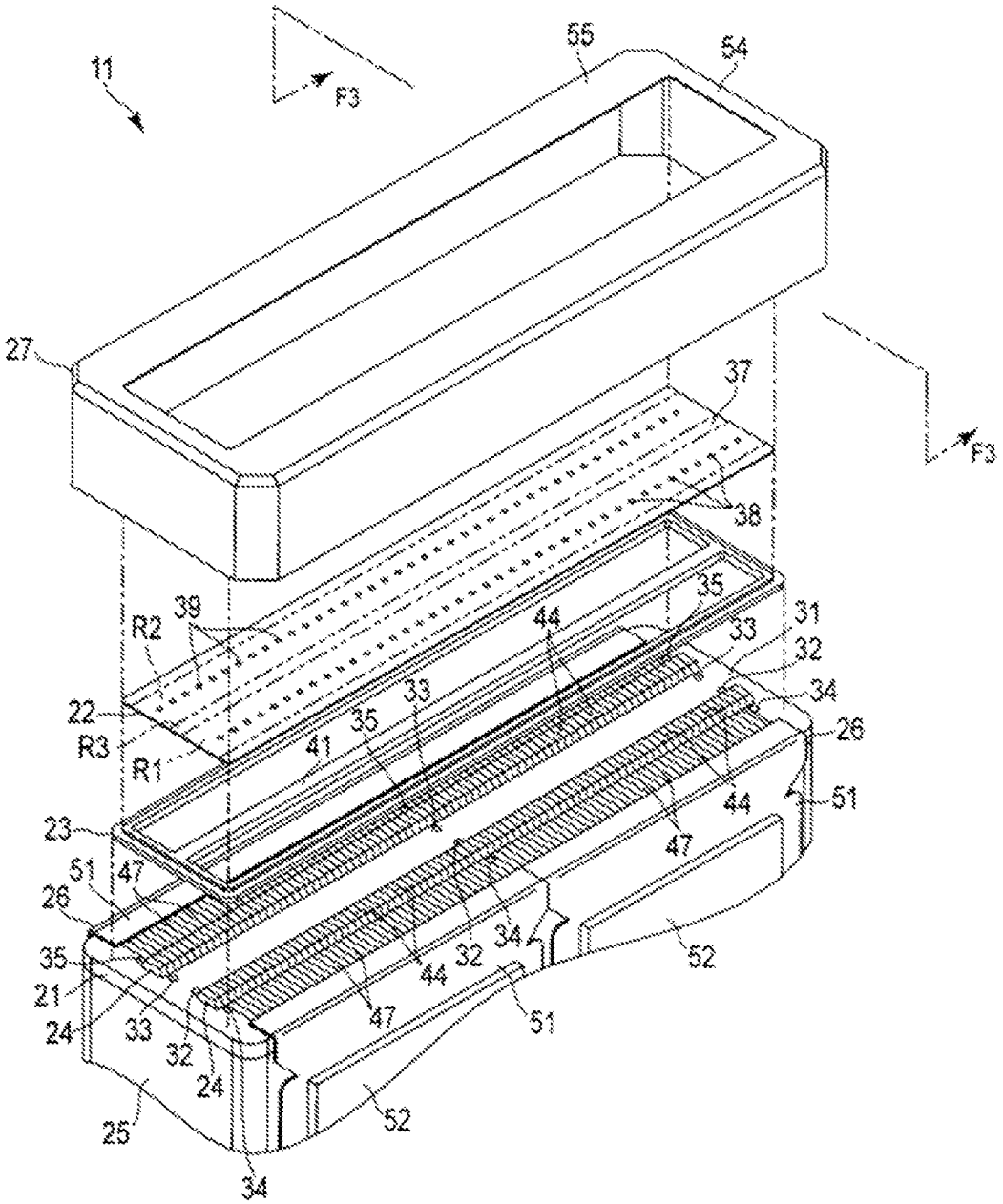

11
F3
55
54
27
37
38
F3
39
R2
R3
R1
22
23
41
35
33
44
31
32
34
26
51
47
52
24
25

Fig.3

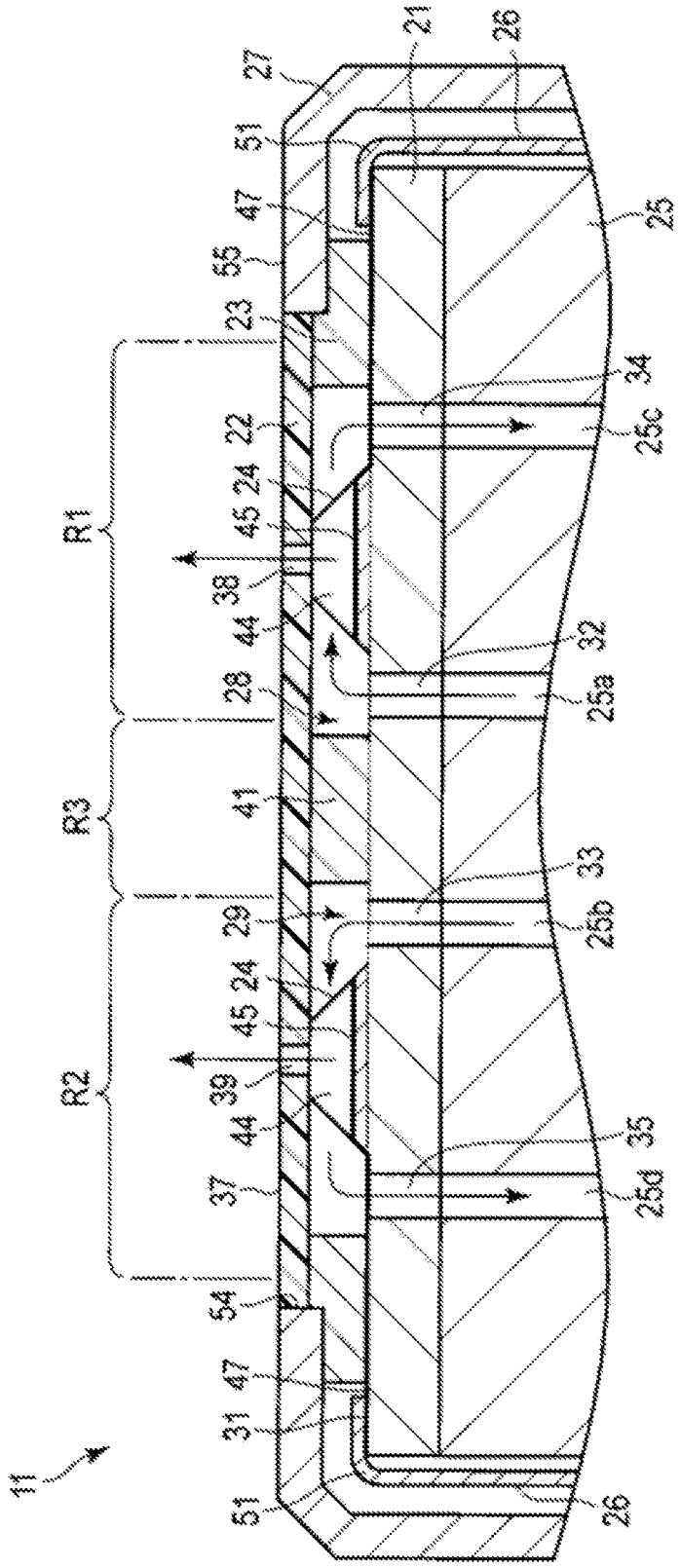

11
R1
R2
R3
21
26
27
51
47
55
23
22
24
45
38
44
28
41
29
39
37
54
31
25
34
25c
32
25a
33
25b
35
25d

Fig.4

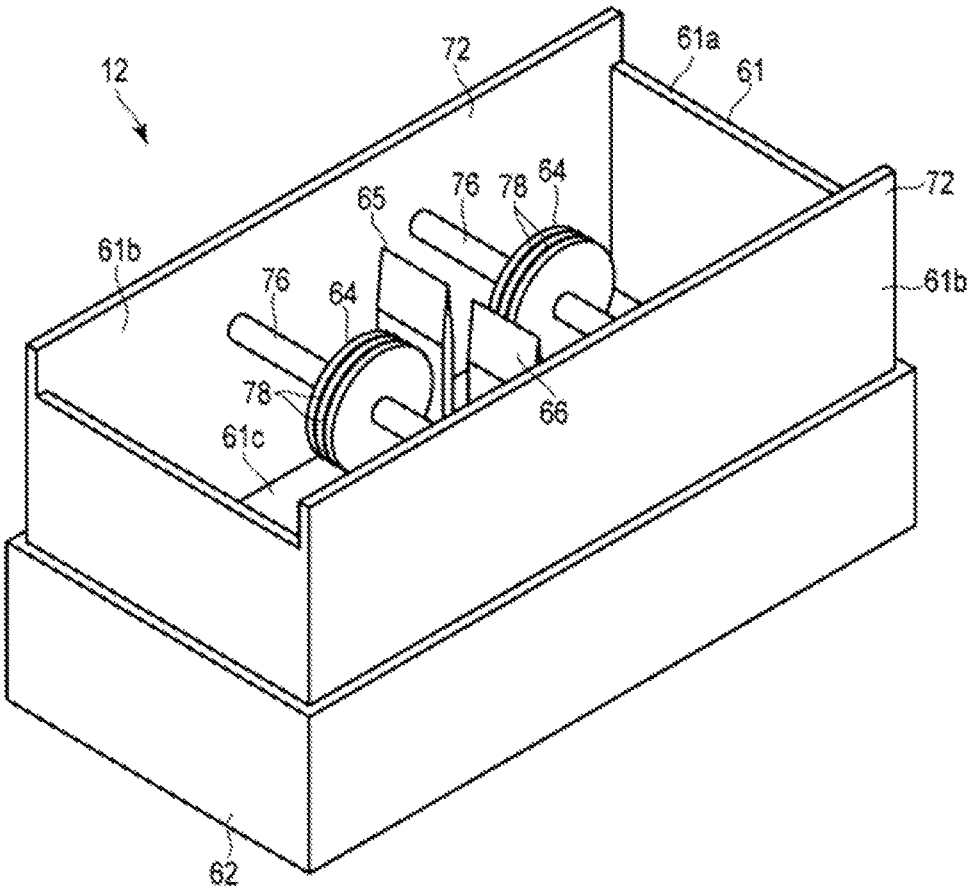


Fig.5

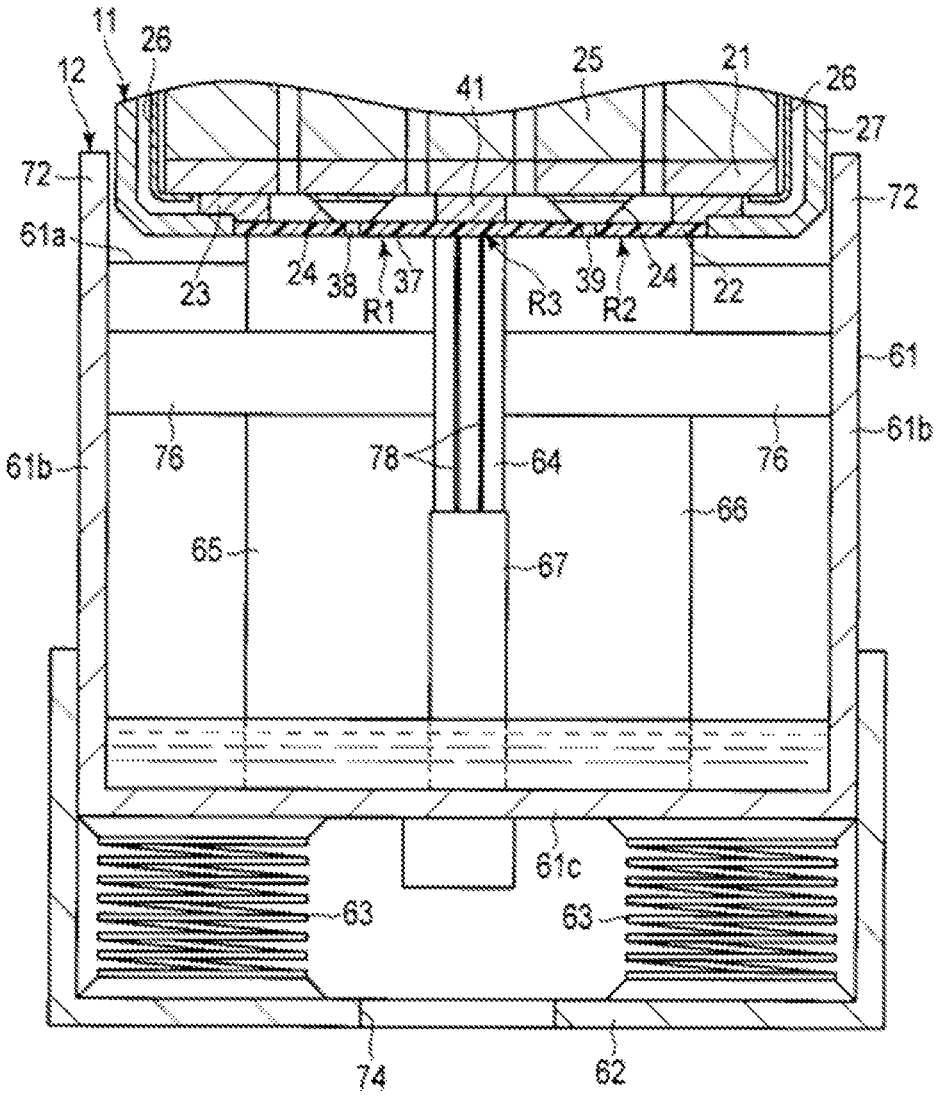

11
26
12
41
25
21
26
27
72
72
61a
23
24
38
37
R1
R3
39
R2
24
22
61
61b
76
78
64
76
61b
66
65
67
61c
63
63
74
62

Fig.6

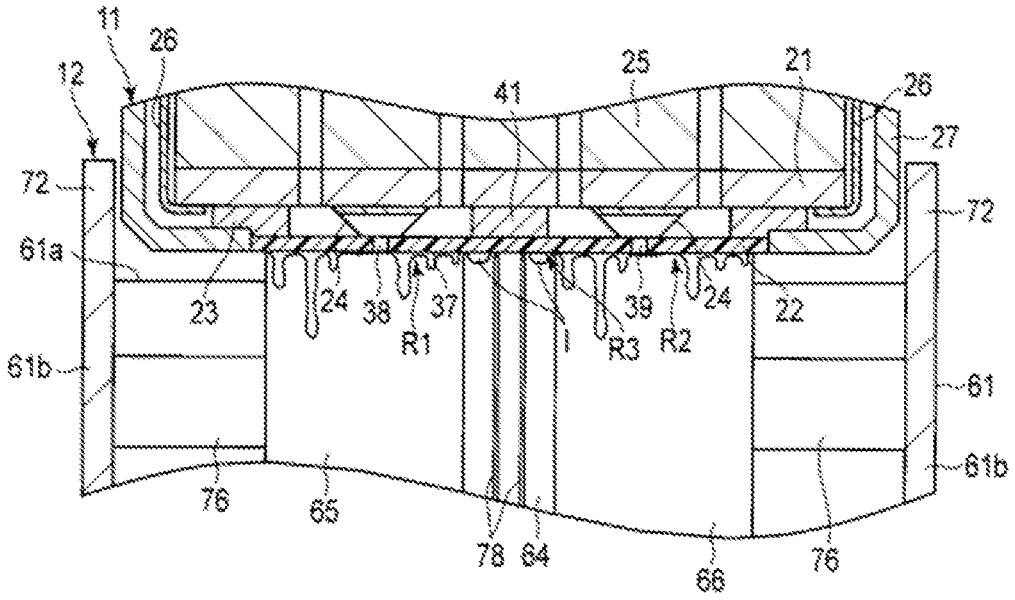

11
26
12
41
25
21
26
27
72
72
61a
23
24
38
R1
37
1
R3
39
R2
24
22
61b
61
61b
76
65
78
64
66
76

Fig.7

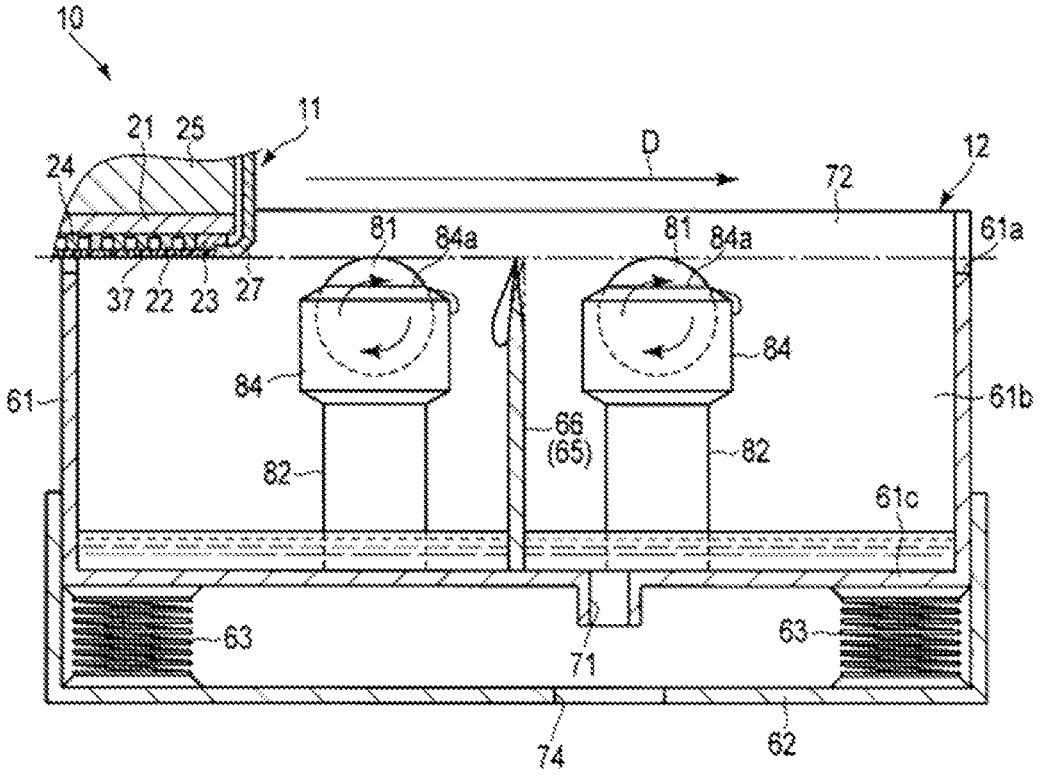
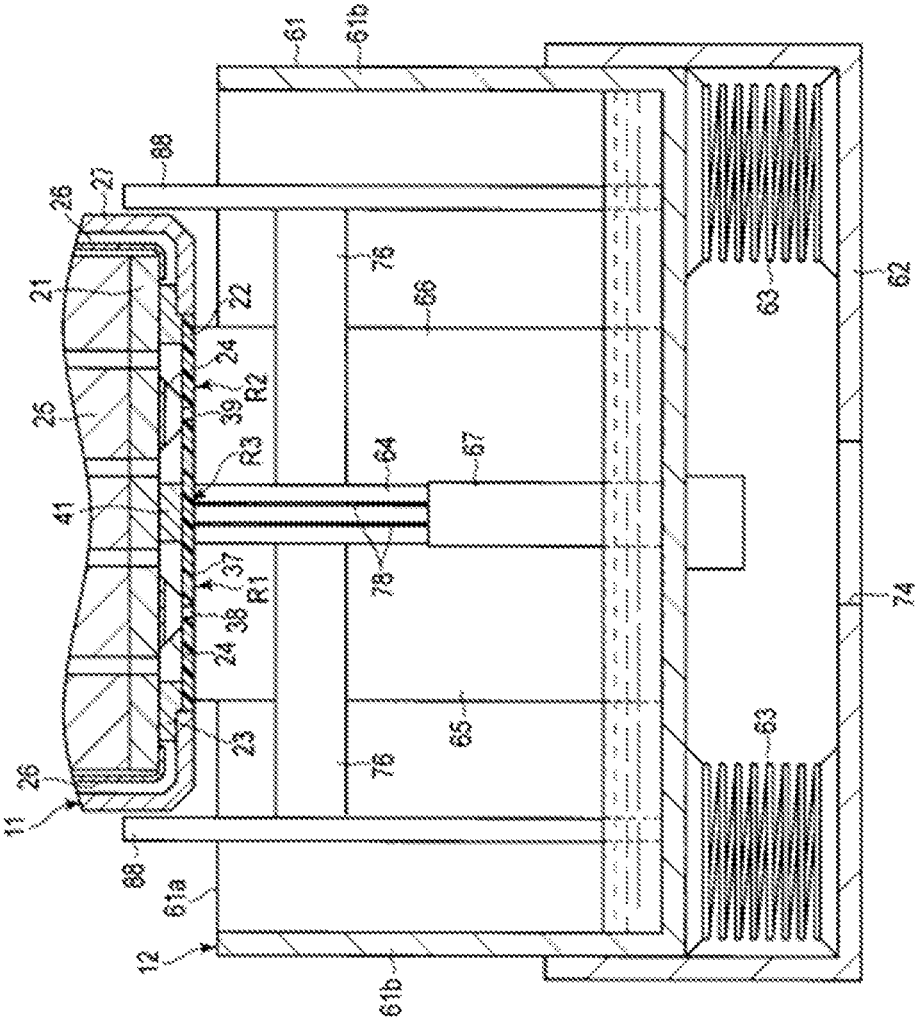

10
11
21
25
24
D
12
72
81
84a
81
84a
61a
37
22
23
27
84
84
61
61b
66
(65)
82
82
61c
63
63
71
74
62

Fig.8


61
61b
88
27
26
21
22
76
66
63
62
24
39
R2
25
R3
64
67
41
37
R1
38
78
74
24
23
65
63
26
11
88
61a
12
61b

MAINTENANCE APPARATUS AND INKJET RECORDING APPARATUS

CROSS-REFERENCE TO RELATED APPLICATION

This application is based upon and claims the benefit of priority from Japanese Patent Application No. 2012-230642, filed Oct. 18, 2012, the entire contents of which are incorporated herein by reference.

FIELD

Embodiments described herein relate generally to a maintenance apparatus and an inkjet recording apparatus.

BACKGROUND

An inkjet head includes an actuator and a pressure chamber in which ink is filled. The actuator is deformed when a driving signal (voltage) is applied thereto and pressurizes the ink filled in the pressure chamber. The pressurized ink is ejected from a nozzle opened in the pressure chamber and forms an image on a printing medium such as recording paper.

The ink sometimes adheres to a nozzle surface on which the nozzle is provided. In order to prevent the ink from staining the printing medium, for example, a wiping blade removes the ink adhering to the nozzle surface.

On the other hand, there is known an inkjet head that ejects two kinds (or two colors) of ink. In the inkjet head, for example, a groove is provided between two nozzles, which eject different kinds of ink, to suppress the kinds of ink wiped by the wiping blades from being mixed between the two nozzles.

When the groove is provided between the two nozzles, it is likely that the ink wiped by the wiping blade remains in the groove. It is likely that, for example, the ink remaining in the groove stains the printing medium and affects printing quality.

DESCRIPTION OF THE DRAWINGS

FIG. **1** is a sectional view of a part of an inkjet printer according to a first embodiment;

FIG. **2** is an exploded perspective view of the inkjet head;

FIG. **3** is a sectional view of the inkjet head taken along line F**3**-F**3** in FIG. **2**;

FIG. **4** is a perspective view of a maintenance apparatus according to the first embodiment;

FIG. **5** is a sectional view of the inkjet head and the maintenance apparatus take along line F**5**-F**5** in FIG. **1**;

FIG. **6** is a sectional view of a part of the inkjet head and the maintenance apparatus taken along line F**6**-F**6** in FIG. **1**;

FIG. **7** is a sectional view of an inkjet head and a maintenance apparatus according to a second embodiment; and

FIG. **8** is a sectional view of a part of an inkjet head and a maintenance apparatus according to a third embodiment.

DETAILED DESCRIPTION

In general, according to one embodiment, there is provided a maintenance apparatus for removing ink from a nozzle surface of an inkjet head including a first region where a first nozzle is provided, a second region where a second nozzle is provided, and a third region located between the first region and the second region. The maintenance apparatus includes a first positioning section, a first wiping blade, and a second wiping blade. The first positioning section comes into contact with the third region and removes ink present in the third region. When the first positioning section comes into contact with the third region, the first wiping blade comes into contact with the first region and removes ink present in the first region. When the first positioning section comes into contact with the third region, the second positioning section comes into contact with the second region and removes ink present in the second region.

A first embodiment is explained below with reference to FIGS. **1** to **6**. Concerning components for which a plurality of expressions are possible, examples of one or more other expressions are sometimes added. This does not deny that different expressions are made concerning components not added with the other expressions and does not restrict other expressions not illustrated herein from being made.

FIG. **1** is a sectional view of a part of an inkjet printer **10** according to the first embodiment. The inkjet printer **10** is an example of an inkjet recording apparatus. The inkjet recording apparatus is not limited to this and may be other apparatuses such as a copying machine.

As shown in FIG. **1**, the inkjet printer **10** includes an inkjet head **11**, a maintenance apparatus **12**, and a waste liquid bottle **13**. The inkjet printer **10** further includes various components such as first and second ink tanks, a circulating device, a control unit, and a recording paper supplying device. In the first and second ink tanks, different colors of ink are stored. For example, black ink is stored in the first ink tank and magenta ink is stored in the second ink tank. In the first and second ink tanks, different kinds of ink of the same color may be stored or ink of the same color and the same kind may be stored.

FIG. **2** is a disassembled perspective view of the inkjet head **11**. FIG. **3** is a sectional view of the inkjet head **11** taken along line F**3**-F**3** in FIG. **2**. As shown in FIG. **2**, the inkjet head **11** is an inkjet head of a so-called side shooter type. The inkjet head **11** ejects two colors of ink to a printing medium such as recording paper and forms a character or an image on the recording medium.

The inkjet head **11** includes a base plate **21**, a nozzle plate **22**, a frame member **23**, a pair of actuators **24**, a manifold **25**, a pair of circuit boards **26**, and an outer frame **27**. As shown in FIG. **3**, a first ink chamber **28** and a second ink chamber **29**, to which kinds of ink are supplied, are formed on the inside of the inkjet head **11**.

As shown in FIG. **2**, the base plate **21** is formed in a rectangular plate shape by ceramics such as alumina. The base plate **21** includes a flat mounting surface **31**. A plurality of first supply holes **32**, a plurality of second supply holes **33**, a plurality of discharge holes **34**, and a plurality of second discharge holes **35** are provided on the mounting surface **31**.

The first and second supply holes **32** and **33** are provided side by side in two rows in the longitudinal direction of the base plate **21** in the center of the base plate **21**. The row of the first supply holes **32** and the row of the second supply holes **33** are arranged in parallel to each other.

As shown in FIG. **3**, the first supply holes **32** communicate with a first ink supply section **25***a* of the manifold **25**. The first supply holes **32** are connected to the first ink tank via the first ink supply section **25***a*. As indicated by an arrow in FIG. **3**, the ink in the first ink tank is supplied from the first supply holes **32** to the first ink chamber **28**.

The second supply holes **33** communicate with a second ink supply section **25***b* of the manifold **25**. The second supply holes **33** are connected to the second ink tank via the second ink supply section **25***b*. As indicated by an arrow in FIG. **3**, the

ink in the second ink tank is supplied from the second supply holes **33** to the second ink chamber **29**.

As shown in FIG. **2**, the first discharge holes **34** are arranged further on the outer side of the base plate **21** than the first supply holes **32**. The second discharge holes **35** are arranged further on the outer side of the base plate **21** than the second supply holes **33**.

As shown in FIG. **3**, the first discharge holes **34** communicate with a first ink discharge section **25***c* of the manifold **25**. The first discharge holes **34** are connected to the first ink tank via the first ink discharge section **25***c*. As indicated by an arrow in FIG. **3**, the ink in the first ink chamber **28** is discharged from the first discharge holes **34** to the ink tank.

The second discharge holes **35** communicate with a second ink discharge section **25***d* of the manifold **25**. The second discharge holes **35** are connected to the second ink tank via the second ink discharge section **25***d*. As indicated by an arrow in FIG. **3**, the ink in the second ink chamber **29** is discharged from the second discharge holes **35** to the ink tank.

As explained above, the kinds of ink circulates between the first and second ink tanks and the first and second ink chambers **28** and **29**.

As shown in FIG. **2**, the nozzle plate **22** is formed by a rectangular film made of, for example, polyimide. The nozzle plate **22** is opposed to the mounting surface **31** of the base plate **21**.

The nozzle plate **22** includes a flat nozzle surface **37**. A plurality of first nozzles **38** and a plurality of second nozzles **39** are provided on the nozzle surface **37**. The plurality of first nozzles **38** are arranged in a row along the longitudinal direction of the nozzle plate **22**. The plurality of second nozzles **39** are arranged in a row in parallel to the row of the first nozzles **38**.

As indicated by alternate long and two dashes lines in FIG. **2**, the nozzle surface **37** includes a first region R**1**, a second region R**2**, and a third region R**3**. The first region R**1** is a rectangular region extending in the longitudinal direction of the nozzle plate **22**. The plurality of first nozzles **38** are provided in the first region R**1**. The second region R**2** is a rectangular region extending in parallel to the first region R**1**. The plurality of second nozzles **39** are provided in the second region R**2**. The third region R**3** is a rectangular region located between the first region R**1** and the second region R**2**.

The first nozzles **38** are opposed to portions between the first supply holes **32** and the first discharge holes **34** on the mounting surface **31**. The second nozzles **39** are opposed to portions between the second supply holes **33** and the second discharge holes **35** on the mounting surface **31**.

The frame member **23** is formed in a rectangular frame shape by, for example, a nickel alloy. The frame member **23** is interposed between the mounting surface **31** of the base plate **21** and the nozzle plate **22**. The frame member **23** is bonded to the mounting surface **31** and the nozzle plate **22**.

The frame member **23** includes a partition wall **41**. The partition wall **41** extends in the longitudinal direction of the base plate **21** in the center of the base plate **21**. The partition wall **41** is also bonded to the mounting surface **31** and the nozzle plate **22**.

As shown in FIG. **3**, the partition wall **41** is arranged to correspond to the third region R**3** of the nozzle surface **37**. In other words, the partition wall **41** supports a portion of the nozzle plate **22** corresponding to the third region R**3**.

The first and second ink chambers **28** and **29** are formed to be surrounded by the base plate **21**, the nozzle plate **22**, and the frame member **23**. The partition wall **41** partitions the first ink chamber **28** and the second ink chamber **29**.

Each of the actuators **24** is formed by a pair of tabular piezoelectric bodies formed of, for example, lead zirconate titanate. The pair of piezoelectric bodies is stuck together such that polarization directions thereof are opposite to each other in the thickness direction of the piezoelectric bodies.

The actuators **24** are bonded to the mounting surface **31** of the base plate **21**. The actuators **24** are bonded to the mounting surface **31** by, for example, an epoxy adhesive having a thermosetting property. The tops of the actuators **24** are bonded to the nozzle plate **22**.

The pair of actuators **24** is respectively arranged in the first and second ink chambers **28** and **29** to correspond to the first and second nozzles **38** and **39**. The pair of actuators **24** is arranged in parallel to each other.

The actuators **24** are formed in a trapezoidal shape in section. A plurality of pressure chambers **44** are provided in the actuators **24**. The pressure chambers **44** are grooves opened in the first or second ink chamber **28** or **29**.

The plurality of pressure chambers **44** extend in a direction crossing the longitudinal direction of the actuators **24** and are arranged in the longitudinal direction of the actuators **24**. The plurality of pressure chambers **44** are provided to correspond to the plurality of first and second nozzles **38** and **39** of the nozzle plate **22**. Therefore, each of the first or second nozzles **38** or **39** are opened in the pressure chambers **44**. Pressure chambers in which the first and second nozzles **38** and **39** are not opened may be present.

As indicated by thick lines in FIG. **3**, electrodes **45** are respectively provided in the plurality of pressure chambers **44**. The electrodes **45** are formed by, for example, a nickel thin film. The electrodes **45** cover the inner surfaces of the pressure chambers **44**.

As shown in FIG. **2**, a plurality of wiring patterns **47** are provided from the mounting surface **31** of the base plate **21** to the actuators **24**. The wiring patterns **47** are formed by, for example, nickel thin films. The wiring patterns **47** extend from the electrodes **45** formed in the pressure chambers **44** of the actuators **24** to side ends of the mounting surface **31**.

The circuit boards **26** are film carrier packages (FCP). The circuit boards **26** include films **51** made of resin having flexibility on which a plurality of wires are formed and ICs **52** connected to the plurality of wires of the films **51**. The FCP is also referred to as tape carrier package (TCP).

The films **51** are tape automated bonding (TAB). The ICs **52** are components for applying a voltage to the electrodes **45**. The ICs **52** are fixed to the films **51** by, for example, resin.

Ends of the films **51** are thermocompression-bonded and connected to the wiring patterns **47** by an anisotropic conductive film (ACF). Consequently, the plurality of wires of the films **51** are electrically connected to the wiring patterns **47**. Since the films **51** are connected to the wiring patterns **47**, the ICs **52** are electrically connected to the electrodes **45** via the wires of the films **51**.

The outer frame **27** is attached to the base plate **21** and the frame member **23** to cover the outer peripheral edges of the base plate **21**, the nozzle plate **22**, and the frame member **23**. The outer frame **27** may be fixed to the base plate **21** and the frame member **23** by, for example, an adhesive or may be fixed to the manifold **25** or other members by, for example, screws.

As shown in FIG. **3**, the outer frame **27** includes an opening section **54** and an outer surface **55**. The nozzle plate **22** and a part of the frame member **23** are fit in the opening section **54**. The opening section **54** is opened in the outer surface **55**. The outer surface **55** is formed to be flush with the nozzle surface

37 of the nozzle plate 22. The nozzle plate 22 may project from the outer surface 55 or may be recessed with respect to the outer surface 55.

The inkjet head 11 ejects ink as explained below. As shown in FIG. 3, the kinds of ink in the first and second ink tanks are respectively supplied from the first and second supply holes 32 and 33 to the first and second ink chambers 28 and 29 through the first and second ink supply sections 25*a* and 25*b* of the manifold 25. The kinds of ink supplied to the first and second ink chambers 28 and 29 are supplied to the plurality of pressure chambers 44 of the actuators 24.

The ICs 52 apply a driving signal (voltage) to the electrodes 45 of the pressure chambers 44 via the wires of the films 51 on the basis of a signal input from the control unit. Consequently, the actuators 24 are deformed in a shear mode.

When the actuators 24 are deformed in a shear mode, the capacity of the pressure chambers 44, in which the electrodes 45 are provided, changes. Consequently, the ink in the pressure chambers 44 is pressurized and ejected from the first or second nozzles 38 or 39 corresponding to the pressure chambers 44. That is, the black ink is ejected from the first nozzles 38 and the magenta ink is ejected from the second nozzles 39.

The kinds of ink remaining without being ejected pass through the pressure chambers 44 and flow out from the first and second discharge holes 34. The kinds of ink are discharged to the first and second ink tanks through the first and second ink discharge sections 25*c* and 25*d* of the manifold 25.

FIG. 4 is a perspective view of the maintenance apparatus 12. FIG. 5 is a sectional view of the inkjet head 11 and the maintenance apparatus 12 taken along line F5-F5 in FIG. 1. The maintenance apparatus 12 is provided to remove ink adhering to the nozzle surface 37 of the inkjet head 11.

The maintenance apparatus 12 moves in an apparatus moving direction D indicated by an arrow in FIG. 1 and removes the ink adhering to the nozzle surface 37. In other words, the apparatus moving direction D is a direction in which the maintenance apparatus 12 wipes the nozzle surface 37. The apparatus moving direction D extends along the longitudinal direction of the nozzle plate 22.

As shown in FIG. 1, the maintenance apparatus 12 includes an ink receiving section 61, a frame 62, a plurality of springs 63, a pair of rollers 64, a first wiping blade 65, a second wiping blade 66, and a pair of third wiping blades 67. The rollers 64 are an example of the first positioning section and a rotating body. The third wiping blades 67 are an example of a cleaning section and the third wiping blade.

The ink receiving section 61 is formed in a rectangular box shape and is opened at an upper end 61*a*. A discharge port 71 is opened in a bottom wall 61*c* of the ink receiving section 61. The discharge port 71 is connected to the waste liquid bottle 13 via, for example, a tube.

As shown in FIG. 5, a pair of guides 72 projects from the upper end 61*a* of the ink receiving section 61. The guides 72 are an example of a second positioning section. The guides 72 are provided integrally with sidewalls 61*b* of the ink receiving section 61 and extend in the apparatus moving direction D. The pair of guides 72 is opposed to each other. The distance between the pair of guides 72 is larger than the width of the inkjet head 11. In other words, the inkjet head 11 can be arranged between the pair of guides 72.

The frame 62 is formed in a rectangular box shape opened at an upper end and houses a lower end of the ink receiving section 61. The plurality of springs 63 are arranged between the ink receiving section 61 and the frame 62. Consequently, the ink receiving section 61 is elastically displaceable with respect to the frame 62.

The frame 62 is attached to a moving device such as an arm or a rail. The maintenance apparatus 12 is moved on the inside of the inkjet printer 10 by the moving device. The maintenance apparatus 12 moves in, for example, the apparatus moving direction D and a direction orthogonal to the nozzle surface 37.

The rollers 64 are formed by, for example, synthetic rubber excellent in ink resistance. The ink resistance indicates durability of a material immersed in ink for a fixed time. The width of the rollers 64 is smaller than the distance between the first nozzles 38 and the second nozzles 39.

The pair of rollers 64 is arranged to correspond to the third region R3 of the nozzle surface 37. The pair of rollers 64 is arranged along the longitudinal direction of the nozzle plate 22.

The pair of rollers 64 rotates around rotating shafts 76. Both ends of the rotating shaft 76 are respectively fixed to, for example, the sidewalls 61*b* of the ink receiving section 61. In other words, the rotating shaft 76 extends in a direction orthogonal to the apparatus moving direction D. The rotating shaft 76 is not limitedly attached to the sidewalls 61*b* and may be attached to other places.

As indicated by an alternate long and short dash line in FIG. 1, the tangent of the two rollers 64 extends along the apparatus moving direction D. The tangent of the two rollers 64 is present in a position higher than the upper end 61*a* of the ink receiving section 61.

As shown in FIG. 4, a plurality of grooves 78 are provided on the outer circumferential surfaces of the rollers 64. The grooves 78 are provided along the circumferential direction of the rollers 64. However, the grooves 78 may be provided along the width direction of the rollers 64.

As shown in FIG. 5, each of the first and second wiping blades 65 and 66 projects from the bottom wall 61*c* of the ink receiving section 61. The first and second wiping blades 65 and 66 are formed by, for example, synthetic rubber excellent in ink resistance.

The first wiping blade 65 is arranged to correspond to the first region R1 of the nozzle surface 37. The second wiping blade 66 is arranged to correspond to the second region R2 of the nozzle surface 37 and arranged side by side with the first wiping blade 65.

As shown in FIG. 1, the first and second wiping blades 65 and 66 are arranged between the pair of rollers 64 in the apparatus moving direction D. The first and second wiping blades 65 and 66 may be arranged in other places.

The distance between the first and second wiping blades 65 and 66 is equal to the width of the rollers 64. The distance between the first and second wiping blades 65 and 66 may be smaller than or may be larger than the width of the rollers 64.

As shown in FIG. 1, the distal ends of the first and second wiping blades 65 and 66 are located on the tangent of the pair of rollers 64. The distal ends of the first and second wiping blades 65 and 66 may project from the tangent of the pair of rollers 64.

Each of the pair of third wiping blades 67 projects from the bottom wall 61*c* of the ink receiving section 61. The third wiping blades 67 are formed by, for example, synthetic rubber excellent in ink resistance.

The pair of third wiping blades 67 is arranged to correspond to the pair of rollers 64. The distal ends of the third wiping blades 67 are in contact with the outer circumferential surfaces of the rollers 64. Therefore, when the rollers 64 rotate, the third wiping blades 67 wipe the outer circumferential surfaces of the rollers 64.

For example, the maintenance apparatus 12 removes ink adhering to the nozzle surface 37 as explained below.

First, the maintenance apparatus **12** is moved to under the inkjet head **11** by the moving device. The maintenance apparatus **12** is brought close to the inkjet head **11** by the moving device to enter between the pair of guides **72**. Consequently, as shown in FIG. **5**, the inkjet head **11** is arranged between the pair of guides **72** and the pair of rollers **64** comes into contact with the third region R**3** of the nozzle surface **37**. In this way, the pair of guides **72** is used for alignment in the width direction of the inkjet head **11** and the maintenance apparatus **12**. The rollers **64** may partially come into contact with the first and second regions R**1** and R**2**. Only one roller **64** may come into contact with the third region R**3**.

When the rollers **64** come into contact with the third region R**3**, the first wiping blade **65** comes into contact with the first region R**1** of the nozzle surface **37**. Further, the second wiping blade **66** comes into contact with the second region R**2**. In this way, the pair of rollers **64** is used for the alignment in the thickness direction of the inkjet head **11** and the maintenance apparatus **12**. The first and second wiping blades **65** and **66** may partially come into contact with the third region R**3**.

When the first and second wiping blades **65** and **66** come into contact with the nozzle surface **37**, the force of the first wiping blade **65** coming into contact with the first region R**1** of the nozzle surface **37** (a bending amount of the first wiping blade **65**) and the force of the second wiping blade **66** coming into contact with the second region R**2** (a bending amount of the second wiping blade **66**) are regulated from increasing to be equal to or larger than a predetermined value. That is, since the pair of rollers **64** comes into contact with the third region R**3** of the nozzle surface **37**, the first and second wiping blades **65** and **66** are prevented from excessively pressing the first and second regions R**1** and R**2**. Further, the plurality of springs **63** are elastically deformed to reduce the forces of first and second wiping blades **65** and **66** coming into contact with the first and second regions R**1** and R**2**.

As shown in FIG. **1**, in a state in which the rollers **64** and the first and second wiping blades **65** and **66** are in contact with the nozzle surface **37**, the moving device moves the maintenance apparatus **12** in the apparatus moving direction D. Consequently, the first wiping blade **65** scrapes and removes the ink present in the first region R**1**. Further, the second wiping blade **66** scrapes and removes the ink present in the second region R**2**. At this point, as indicated by an alternate long and two dashes line in FIG. **1**, the first and second wiping blades **65** and **66** may bend. The scraped ink drips to the inside of the ink receiving section **61** from the first and second wiping blades **65** and **66**.

FIG. **6** is a sectional view of a part of the inkjet head **11** and the maintenance apparatus **12** taken along line F**6**-F**6** in FIG. **1**. As shown in FIG. **6**, parts I of the kinds of ink scraped by the first and second wiping blades **65** and **66** are moved aside to the center of the nozzle surface **37**. In other words, the parts I of the kinds of ink adhering to the first and second regions R**1** and R**2** move to the third region R**3**.

After the first and second wiping blades **65** and **66** remove the kinds of ink adhering to the first and second regions R**1** and R**2**, the rollers **64** rotationally move in the third region R**3**. The rollers **64** remove the ink adhering to the third region R**3** and the parts I of the kinds of ink moved from the first and second regions R**1** and R**2**. The kinds of ink adhere to the outer circumferential surfaces of the rollers **64** and further intrudes into the grooves **78** of the rollers **64**.

As shown in FIG. **1**, the ink removed by the rollers **64** drips to the inside of the ink receiving section **61** according to the rotation of the rollers **64**. Further, the ink adhering to the outer circumferential surfaces of the rollers **64** is scraped and removed by the third wiping blades **67**. The scraped ink drips to the inside of the ink receiving section **61** from the third wiping blades **67**.

As explained above, the ink receiving section **61** receives the kinds of ink removed by the pair of rollers **64** and the first and second wiping blades **65** and **66**. The ink is discharged from the discharge port **71** of the ink receiving section **61** to the waste liquid bottle **13**.

The maintenance apparatus **12** moves a plurality of times in the apparatus moving direction D and the opposite direction of the apparatus moving direction D. When the maintenance apparatus **12** moves in the opposite direction of the apparatus moving direction D, the maintenance apparatus **12** also removes the ink adhering to the nozzle surface **37**. Consequently, the ink is removed from the nozzle surface **37**. After the ink is removed, the moving device moves the maintenance apparatus **12** away from the inkjet head **11** and arranges the maintenance apparatus **12** in a predetermined position.

In the inkjet printer **10** according to the first embodiment, the rollers **64** perform the alignment in the thickness direction of the inkjet head **11** and the first and second wiping blades **65** and **66**. The rollers **64** remove the ink present in the third region R**3** of the nozzle surface **37**. Consequently, it is possible to suppress the ink from remaining in the third region R**3** and suppress the two colors of ink from being mixed. It is possible to suppress excess ink accumulated in the third region R**3** from adhering to a printing medium such as recording paper. Further, it is possible to suppress the first and second wiping blades **65** and **66** from excessively moving toward the nozzle surface **37** and damaging the nozzle surface **37**.

As shown in FIG. **5**, a portion of the nozzle plate **22** corresponding to the third region R**3** is supported by the partition wall **41**. Consequently, the force of the rollers **64** coming into contact with the third region R**3** is received by the partition wall **41**. It is possible to suppress the force from damaging the nozzle plate **22**.

The rollers **64** come into contact with the nozzle surface **37** to regulate the forces of the first and second wiping blades **65** and **66** coming into contact with the nozzle surface **37**. Consequently, it is possible to suppress the first and second wiping blades **65** and **66** from excessively pressing and damaging the nozzle surface **37**.

The rollers **64** can rotationally move in the apparatus moving direction D on the third region R**3**. Consequently, even if the rollers **64** come into contact with the nozzle surface **37**, the maintenance apparatus **12** can smoothly move in the apparatus moving direction D.

The plurality of grooves **78** are provided on the outer circumferential surfaces of the rollers **64**. Therefore, the ink adhering to the third region R**3** is absorbed in the grooves **78** by the capillary effect. Consequently, it is possible to efficiently remove the ink present in the third region R**3**.

The third wiping blades **67** remove the ink present on the outer circumferential surfaces of the rollers **64**. Consequently, it is possible to suppress the ink removed by the rollers **64** from remaining on the outer circumferential surfaces of the rollers **64** and adhering to the third region R**3** again.

When the first and second wiping blades **65** and **66** come into contact with the first and second regions R**1** and R**2** and the rollers **64** come into contact with the third region R**3**, the inkjet head **11** is arranged between the two guides **72**. In other words, the pair of guides **72** performs the alignment in the width direction of the inkjet head **11** and the maintenance apparatus **12**. Consequently, it is possible to, for example,

suppress the rollers **64** from coming into contact with the first or second region R**1** or R**2** and suppress the nozzle surface **37** from being damaged.

The pair of guides **72** is provided in the ink receiving section **61**. Consequently, it is possible to suppress increases in material costs and work processes due to provision of the guides **72**.

The springs **63** reduce the force of the rollers **64** coming into contact with the third region R**3**. Consequently, it is possible to suppress the pair of rollers **64** and the first and second wiping blades **65** and **66** from excessively pressing the nozzle surface **37**.

A second embodiment is explained with reference to FIG. **7**. In at least one embodiment disclosed below, components having the same functions as the inkjet printer **10** according to the first embodiment are denoted by the same reference numerals and signs. Further, explanation concerning the components is sometimes partly or entirely omitted.

FIG. **7** is a sectional view of the inkjet head **11** and the maintenance apparatus **12** according to the second embodiment. As shown in FIG. **7**, the maintenance apparatus **12** according to the second embodiment includes a pair of balls **81** and a pair of supporting bodies **82** instead of the rollers **64** and the third wiping blades **67**. The balls **81** are an example of the first positioning section and the rotating body. The pair of supporting bodies **82** is an example of the cleaning section.

The supporting bodies **82** project from the bottom surface **61***c* of the ink receiving section **61**. Housing sections **84** are provided in the supporting bodies **82**. Upper ends **84***a* of the housing sections **84** are opened. The balls **81** are rotatably housed in the housing sections **84**. A part of the balls **81** projects from the opened upper ends **84***a* of the housing sections **84**. The edges of the upper ends **84***a* are in contact with the outer circumferential surfaces of the balls **81**.

The balls **81** are formed by, for example, synthetic rubber excellent in ink resistance. The pair of balls **81** is arranged to correspond to the third region R**3** of the nozzle surface **37**. The pair of balls **81** is arranged along the longitudinal direction of the nozzle plate **22**.

As indicated by an alternate long and short dash line in FIG. **7**, the tangent of the two balls **81** extends along the apparatus moving direction D. The tangent of the two balls **81** is present in a position higher than the upper end **61***a* of the ink receiving section **61**.

Like the rollers **64** in the first embodiment, the balls **81** come into contact with the third region R**3** of the nozzle surface **37**. The pair of balls **81** is used for the alignment in the thickness direction of the inkjet head **11** and the maintenance apparatus **12**.

When the maintenance apparatus **12** moves in the apparatus moving direction D, after the first and second wiping blades **65** and **66** remove kinds of ink adhering to the first and second regions R**1** and R**2**, the balls **81** rotationally move in the third region R**3**. The balls **81** remove ink adhering to the third region R**3** and the parts I of the kinds of ink moved from the first and second regions R**1** and R**2**.

As shown in FIG. **7**, the ink removed by the balls **81** is scraped and removed by the edges of the upper ends **84***a* of the housing sections **84**. The scraped ink drips to the inside of the ink receiving section **61** from the supporting bodies **82**.

As explained in the second embodiment above, the rotating body is not limited to the rollers **64** and may be the balls **81** and other components. Further, the first positioning section is not limited to the rotating body and may be, for example, other components such as a column having a low coefficient of friction in a portion in contact with the nozzle surface **37**.

A third embodiment is explained with reference to FIG. **8**. FIG. **8** is a sectional view of a part of the inkjet head **11** and the maintenance apparatus **12** according to the third embodiment. As shown in FIG. **8**, the inkjet head **11** according to the third embodiment includes a pair of guides **88**. The guides **88** are an example of the second positioning section.

The guides **88** are formed in a tabular shape projecting from the bottom wall **61***c* of the ink receiving section **61**. The guides **88** extend along the apparatus moving direction D. The pair of guides **88** is opposed to each other. The distance between the pair of guides **88** is larger than the width of the inkjet head **11**.

The pair of rollers **64** is arranged between the pair of guides **88**. Both ends of the rotating shaft **76** are fixed to the guides **88**. The rotating shaft **76** may be fixed to the sidewalls **61***b* of the inkjet section **61**.

As explained in the third embodiment above, the second positioning section is not limited to the guides **72** provided in the ink receiving section **61** and may be other members such as the tabular guides **88** and rollers that come into contact with the side surfaces of the inkjet head **11**.

In at least one of the maintenance apparatuses explained above, when the first positioning section comes into contact with the third region of the nozzle surface, the first and second wiping blades come into contact with the first and second regions of the nozzle surface. The first and second wiping blades remove kinds of ink present in the first and second regions and the first positioning section removes ink present in the third region. Consequently, it is possible to suppress the ink from remaining on the nozzle surface.

As anther example, a base of the first wiping blade **65** and a base of the second wiping blade **66** may be connected. In other words, the first and second wiping blades **65** and **66** may be integrally formed. When the inkjet head **11** moves, the maintenance apparatus **12** may remove the ink present on the nozzle surface **37**. Grooves that engage with the rollers **64** may be provided in the nozzle plate **22**.

While the several embodiments have been explained, these embodiments have been presented by way of example only, and are not intended to limit the scope of the inventions. Indeed, the novel embodiments described herein may be embodied in a variety of other forms; furthermore, various omissions, substitutions, and changes in the form of the embodiments described herein may be made without departing from the spirit of the inventions. The accompanying claims and their equivalents are intended to cover such forms or modifications as would fall within the scope and spirit of the inventions.

What is claimed is:

1. A maintenance apparatus for removing ink from a nozzle surface of an inkjet head including a first region where a first nozzle is provided, a second region where a second nozzle is provided, and a third region located between the first region and the second region, the maintenance apparatus comprising:

a first positioning section configured to come into contact with the third region and remove ink present in the third region;

a first wiping blade configured to, when the first positioning section comes into contact with the third region, come into contact with the first region and remove ink present in the first region; and

a second wiping blade configured to, when the first positioning section comes into contact with the third region, come into contact with the second region and remove ink present in the second region,

wherein the first positioning section comes into contact with the nozzle surface to regulate a force of the first wiping blade coming into contact with the first region from increasing to be equal to or larger than a predetermined value and regulate a force of the second wiping blade coming into contact with the second region from increasing to be equal to or larger than a predetermined value.

2. The apparatus according to claim **1**, wherein the first positioning section includes a rotating body configured rotatably come into contact with the third region.

3. The apparatus according to claim **2**, wherein a groove is provided on an outer circumferential surface of the rotating body.

4. The apparatus according to claim **3**, further comprising a cleaning section configured to remove the ink present on the outer circumferential surface of the rotating body.

5. The apparatus according to claim **4**, wherein the cleaning section includes a third wiping blade configured to remove the ink present on the outer circumferential surface of the rotating body.

6. The apparatus according to claim **5**, further comprising a pair of second positioning sections, wherein

when the first wiping blade comes into contact with the first region, the second wiping blade comes into contact with the second region, and the first positioning section comes into contact with the third region, the inkjet head is arranged between the pair of second positioning sections.

7. The apparatus according to claim **6**, further comprising an ink receiving section configured to receive the kinds of ink removed by the first positioning section and the first and second wiping blades and including the pair of second positioning sections.

8. The apparatus according to claim **7**, further comprising a spring for reducing the force of the first positioning section coming into contact with the third region.

9. An inkjet recording apparatus comprising:

an inkjet head; and

a maintenance apparatus for removing ink from a nozzle surface of the inkjet head including a first region where a first nozzle is provided, a second region where a second nozzle is provided, and a third region located between the first region and the second region, the maintenance apparatus comprising:

a first positioning section configured to come into contact with the third region and remove ink present in the third region;

a first wiping blade configured to, when the first positioning section comes into contact with the third region, come into contact with the first region and remove ink present in the first region; and

a second wiping blade configured to, when the first positioning section comes into contact with the third region, come into contact with the second region and remove ink present in the second region,

wherein the first positioning section comes into contact with the nozzle surface to regulate a force of the first wiping blade coming into contact with the first region from increasing to be equal to or larger than a predetermined value and regulate a force of the second wiping blade coming into contact with the second region from increasing to be equal to or larger than a predetermined value.

10. An inkjet recording apparatus comprising:

an inkjet head comprising a nozzle surface including a first region having a first nozzle to discharge first ink, a second region having a second nozzle to discharge second ink different in type or color from the first ink, and a third region between the first region and the second region;

a roller comprising a plurality of circumferentially-formed grooves on an outer circumferential surface, the roller configured to contact the third region to remove the first or second ink in the third region and used for positioning in a thickness direction with respect to the inkjet head;

a first wiping blade configured to contact the first region when the roller contacts the third region, and to remove the first ink in the first region; and

a second wiping blade configured to contact the second region when the roller contacts the third region, and to remove the second ink in the second region.

11. The apparatus according to claim **10**, wherein the roller is configured to contact the nozzle surface to regulate a force of the first wiping blade contacting the first region from increasing to be equal to or larger than a predetermined value and regulate a force of the second wiping blade contacting the second region from increasing to be equal to or larger than a predetermined value.

12. The apparatus according to claim **10**, further comprising a third wiping blade configured to remove ink on the outer circumferential surface of the roller.

13. The apparatus according to claim **12**, further comprising a pair of positioning sections, wherein

the inkjet head is between the pair of positioning sections when the first wiping blade contacts the first region, the second wiping blade contacts the second region, and the roller contacts the third region.

14. The apparatus according to claim **13**, further comprising an ink receiving section configured to receive the ink removed by the roller and the first and second wiping blades, the ink receiving section comprising the pair of positioning sections.

15. The apparatus according to claim **14**, further comprising a spring for reducing a force of the roller contacting the third region.

16. The apparatus according to claim **10**, wherein an upper end of the roller and upper ends of the first and second wiping blades are co-located in the thickness direction.

* * * * *